About the stratigraphic position of the Lower Aptian Roloboceras hambrovi (Ammonoidea) level

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About the stratigraphic position of the Lower Aptian *Roloboceras hambrovi* (Ammonoidea) level

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Abstract: In the stratotype of the Lower Aptian substage the position of the assemblage that includes *Roloboceras* spp. and *Megatyloceras* spp. has been clearly established as being in the middle part of the upper Bedoulian. Some authors have erected this horizon as a subzone, or even a zone, with *R. hambrovi* as species-index. In other areas (southern England, eastern Spain, the Ardèche in southeastern France), where taphonomic conditions are not always as favourable as they are in the stratotype, the level at which this assemblage occurs seems to be confined to the upper part of the lower Bedoulian. Various hypotheses are considered in an attempt to explain this divergence.

Key Words: Biostratigraphy; ammonites; Cretaceous; Aptian.

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Résumé : ***Sur la position stratigraphique du niveau à* Roloboceras hambrovi *(Ammonoidea) dans l'Aptien inférieur.-*** L'association à *Roloboceras* spp. et *Megatyloceras* spp. est clairement positionnée dans la partie moyenne du Bédoulien supérieur dans le stratotype du sous-étage, au point d'avoir été érigée en sous-zone ou même en zone, avec *R. hambrovi* comme espèce-index, par certains auteurs. En d'autres régions (S. Angleterre, Espagne orientale, Ardèche), où les conditions de gisement ne sont cependant pas toujours aussi favorables que dans le stratotype, cette association semblerait plutôt confinée à la partie supérieure du Bédoulien inférieur. Diverses hypothèses sont considérées en vue de tenter d'expliquer cette divergence.

Mots-Clefs : Biostratigraphy; ammonites; Cretaceous; Aptian.

In 1984, after intensive research concerning the ammonites collected in the Cassis railway station-Comte Quarry section of the Bedoulian (= Lower Aptian) stratotypic area, BUSNARDO introduced a new succession of "zonal sub-divisions" for this substage. These zones were not formally defined but simply indicated graphically in a table together with a log of the type-section (Fig. 1).

In BUSNARDO's (1984) zonal succession one can notice a Hambrovi Zone, thus implying that *Roloboceras hambrovi* be regarded as its species-index. The corresponding level is the base of the upper Bedoulian, in compliance with a ternary mode for the subdivision of this substage. This Hambrovi Zone overlies a Matheroni Zone (= upper middle Bedoulian) and is below a Grandis Zone (= middle upper Bedoulian). Note that in the table of species ranges provided by this author (Fig. 2), *Deshayesites deshayesi* is absent. Later, the ternary mode of subdivision of the Bedoulian was replaced by a binary one (DELANOY *et alii*, 1997) and the boundary between lower and upper Bedoulian placed at the top of bed 128 (top of the Weissi Zone) in the stratotype section.

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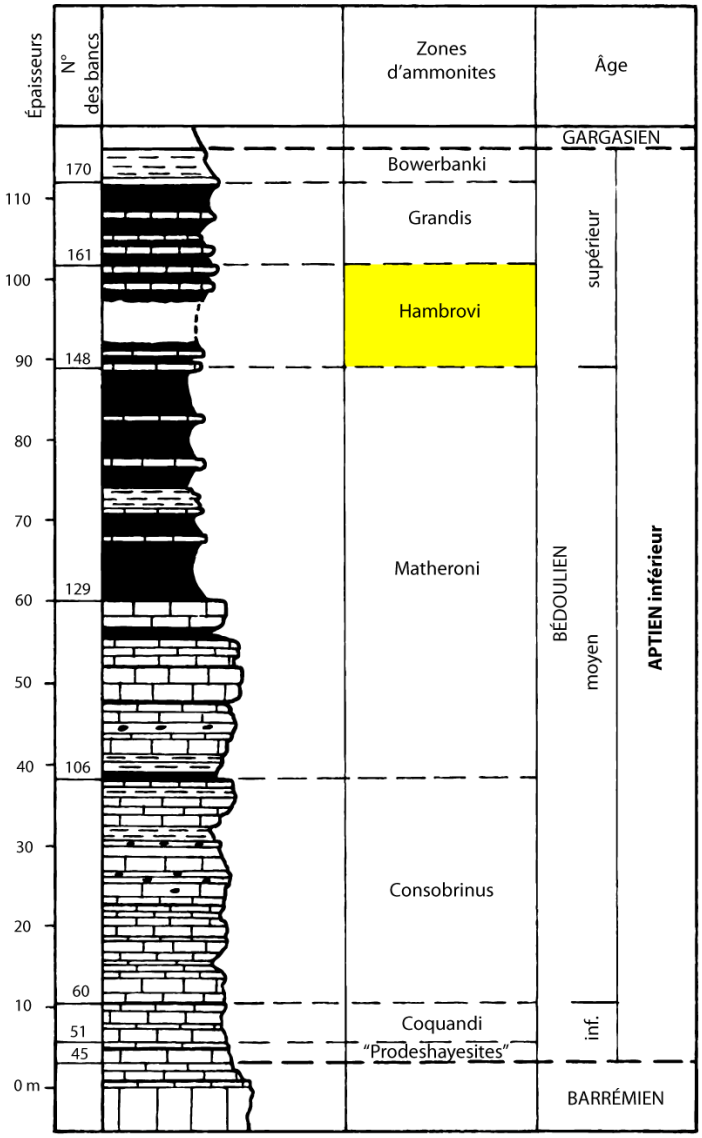

Figure 1: Bedoulian stratotype: Cassis-La Bédoule railway station section and ammonite zonation, as published by BUSNARDO (1984).

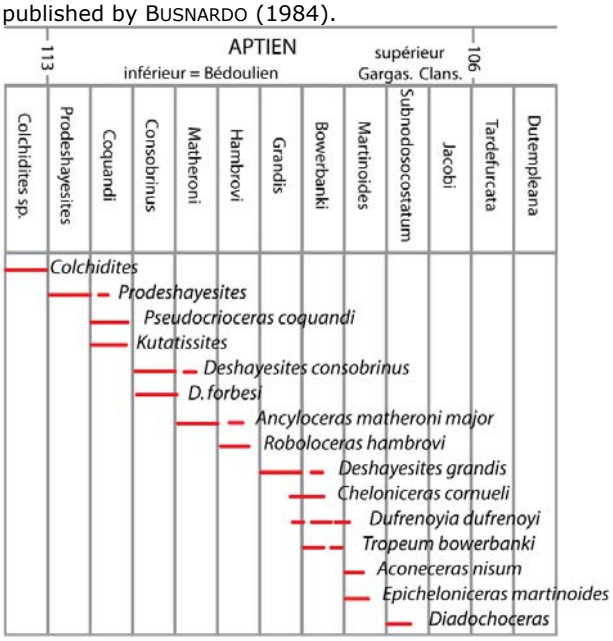

Figure 2: Stratigraphic range of the main species of Aptian ammonites, as published by BUSNARDO (1984).

The presence of the genus *Roloboceras* in the stratotype area had already been mentioned by several authors. Between Cassis and La Bédoule, ROCH (1927, p. 8) had identified *Douvilleiceras* cf. *hambrovii* in the upper part of the Lower Aptian succession, above a "typical" *Parahoplites deshayesi* level. At Cassis, in the Comte Quarry section, CONTE (1975) described a *Roloboceras* gr. *transiens* from the upper part of the Bedoulian, more precisely "à quelques 12 m. de la partie supérieure du Bédoulien (niveau à *Tropaeum*), au dessus de la partie moyenne dans laquelle abondent les *D. deshayesi*" (*op. cit.*, p. 108). This occurrence was confirmed by DELANOY (pers. comm., 1996), who identified in the Comte Quarry section, in bed 148: *Roloboceras* gr. *hambrovi*, *Megatyloceras* aff. *coronatum*, *M.* aff. *ricordeanum*, *Pseudohaploceras liptoviense*, *Cymatoceras neocomiensis*, and in bed 150: *Roloboceras* sp., *Pseudohaploceras* sp.

Our own record of ammonites in the Comte Quarry section (ROPOLO *et alii*, 2000, 2006) can be summarized as follows (see also Fig. 3):

- beds 129, 130, 135, 150: *Deshayesites deshayesi* [see ROPOLO *et alii*, 2006, p. 9-10, pl. 10, figs. 1-2].
- bed 137: *Deshayesites* sp. aff. *rarecostatus*, *Deshayesites* cf. *dechyi*.
- bed 148: *Roloboceras hambrovi*, *Megatyloceras ricordeanum*, *Megatyloceras* aff. *coronatum*.
- bed 149: *Roloboceras* sp.
- bed 150: *Roloboceras* gr. *transiens*, *Megatyloceras coronatum*.
- bed 158: *Roloboceras hambrovi*, *Megatyloceras coronatum*.
- bed 159: *Deshayesites* cf. *gracilis*.
- beds 161a, 164, 166: *Paradeshayesites grandis* [see ROPOLO *et alii*, 2006, p. 15, pl. 10, figs. 3 & 5; pl. 11, fig. 1], *Deshayesites geniculatus*.
- beds 165, 168: *Paradeshayesites* cf. *involutus*.
- bed 170: *Roloboceras horridum*.

The findings of all these authors are concordant in the premise that a *Roloboceras* and *Megatyloceras* level is indisputably present at Cassis-La Bédoule. More precisely, in the 110m thick succession representing the Lower Aptian substage there, these ammonites occur very high in the series, that is between 80 and 100m, and are found above and together with certain species of Deshayesitidae that characterize the upper Bedoulian (in compliance with the most frequently used binary mode of subdivision).

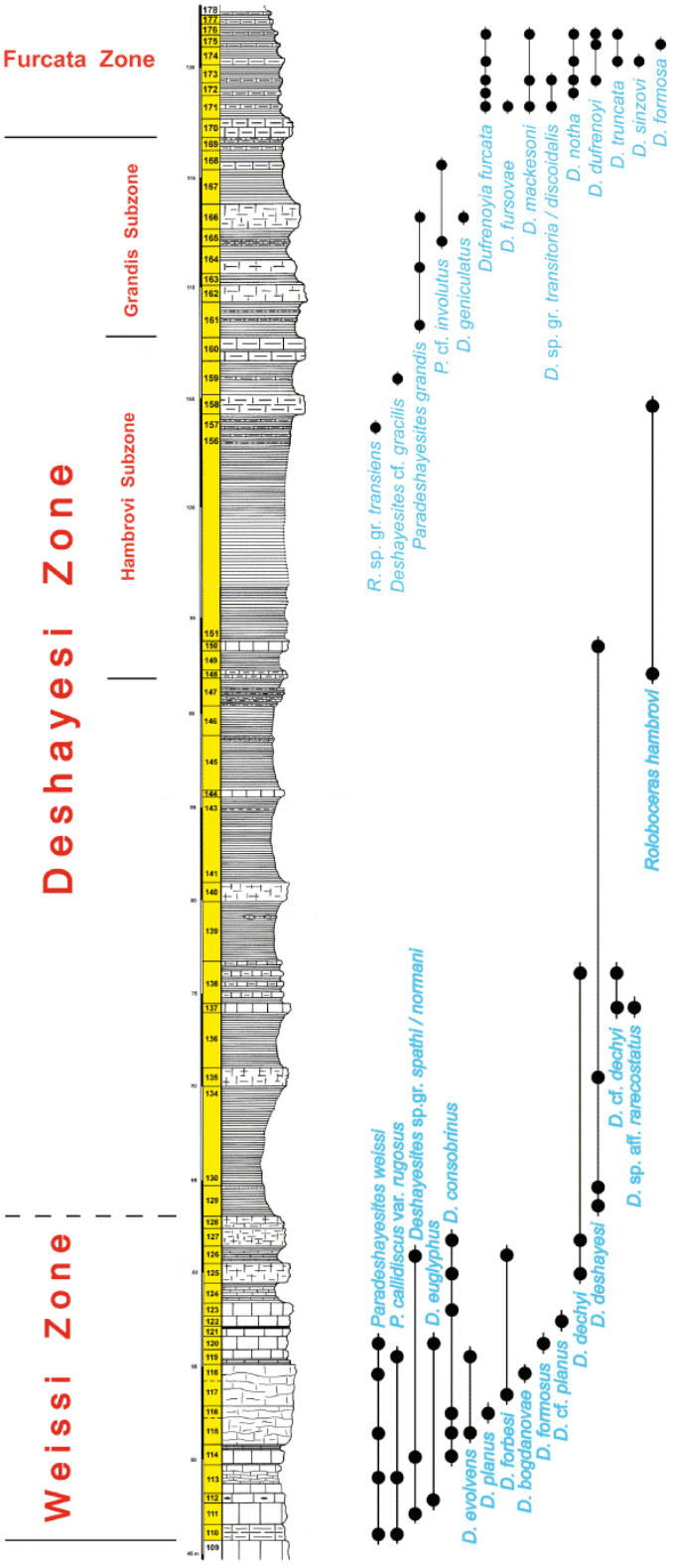

Figure 3: Cassis-La Bédoule railway station section: stratigraphic range of the Deshayesitidae and Roloboceratinae (from ROPOLO *et alii*, 2006).

However, a compilation of the principal discoveries of Roloboceratinae in both the Tethyan (Ardèche, Spain) and Boreal (southern England) Aptian reveals a stratigraphic position which sometimes differs from that observed in the stratotype.

Thus KILIAN & REBOUL (1915) mention (p. 8) the presence of *Douvilleiceras Hambrowii* [*sic*] in the calcareous complex located between Le Teil and the Lafarge quarries on the right bank of the Rhone; the authors draw a parallel between this complex and the limestones of the l'Homme d'Armes section, located on the left bank, near Montélimar, which are dated early Bedoulian on the basis of an ammonite fauna that in particular includes *Parahoplites Weissi*. In their summary list of the Lower Aptian fauna from southeastern France, KILIAN & REBOUL (1915) mention (p. 118) *Douvilleiceras Hambrowii* in such outcrops as "Bourg-Saint-Andéol, Lafarge", in the text attributed to the lower Bedoulian. However, p. 176, in the locality of Opoul, near Perpignan, the same authors report *Douvilleiceras Hambrowii* in association with typical and abundant *Parahoplites furcatus*, and relate their level to that of the "marnes inférieures" of La Clape (near Narbonne), which they attribute to "du Bédoulien très supérieur" [uppermost Bedoulian].

These somewhat divergent data appear to support CASEY's (1961a) opinion who wrote (p. 496): "*Roloboceras hambrovi* has too long a range".

In England, as early as 1923 "*Roloboceras hambrovi* was used by SPATH" (...) "as a guide fossil for the middle part of the old deshayesi Zone, which corresponds more or less to the Lower Aptian of present usage" (quotation in CASEY, 1961b, p. 182). From the work of CASEY (1961a, 1961b) and CASEY *et alii* (1998) on the Aptian of the Lower Greensand, it is clear that in southern England the several species of *Roloboceras* (associated with *Megatyloceras*) are confined to the Forbesi Zone, which can be taken as the equivalent of the Tethyan Weissi Zone and represents the upper part of the lower Bedoulian (Fig. 4).

The various *Roloboceras* and *Megatyloceras* collected and studied by SORNAY & MARIN (1972) in Spain (Tejeria de Josa section, Oliete basin, prov. Teruel) are said by the authors to indicate the upper lower Bedoulian, without further explanation ("toute cette faune indique le sommet du Bédoulien inférieur, un niveau plus élevé étant exclu"). One might assume that the authors are led to this categorical assignment on the basis of CASEY's work. But MARIN & SORNAY, working in the same sector, wrote in 1971: "les attributions stratigraphiques ont été faites en tenant compte de la zonation admise en Europe septentrionale (Grande-Bretagne). Il n'est pas absolument certain, compte tenu de migrations faunistiques possibles, que cette zonation soit strictement applicable à la Péninsule ibérique" [Stratigraphic attributions were made taking into account the zonation accepted in northern Europe (Great Britain). It

is not absolutely certain in view of possible faunal migrations that this zonation is strictly applicable on the Iberian peninsula].

Let us add that the age of the series underlying the fossiliferous bed of the Tejeria de Josa section is not constrained, for this stratum rests on a thin marly level (that overlies a massive undated limestone through a significant hardground) in which the only "marker" is *Palorbitolina lenticularis*; the range of this orbitolinid is upper Barremian and Bedoulian (GUSIC, 1981; CLAVEL *et alii*, 1995; ARNAUD *et alii*, 1998), the Furcata Zone included. In 1965, WIEDMANN, for this same area of the Maestrazgo of the Celtiberic Chain (including the Oliete basin), indicated (Table III) above an "Aptien I" with *Deshayesites weissi* and *D. consobrinus*, an "Aptien II" (or "Rolobocératien") including *Roloboceras hambrovi*, *Dufrenoya* cf. *lurensis*, *Deshayesites deshayesi*, *Pseudosaynella*, various nautiloids, *etc.*, thus dated upper Bedoulian. These data were not taken into account by MARIN & SORNAY (1971), stating only: "il semble" (...) "que les divisions récemment proposées [par WIEDMANN] pour cette région d'Espagne ne puissent être retenues".

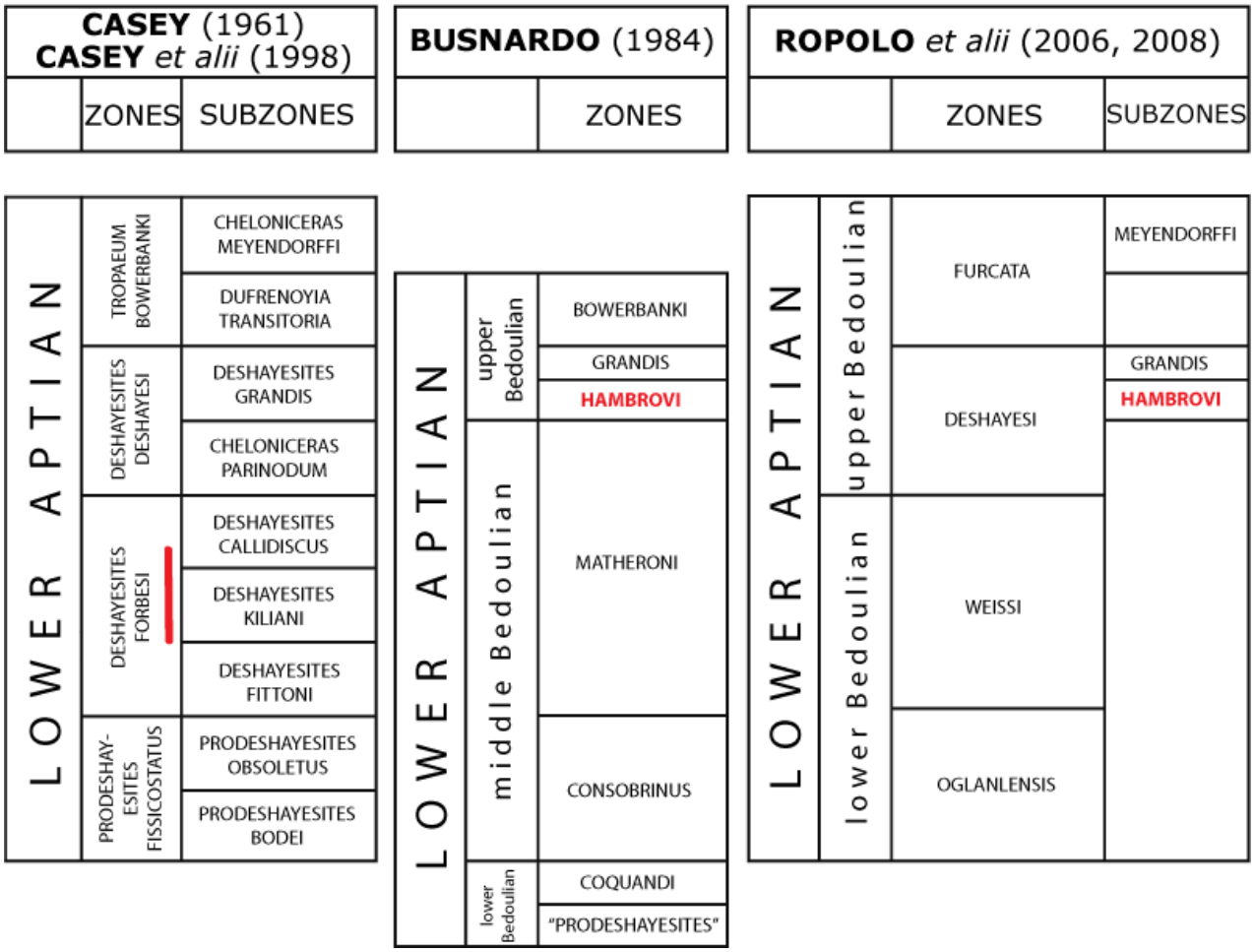

Figure 4: Correlation between the Lower Aptian ammonite zonations of CASEY (1961a, 1998), BUSNARDO (1984) and ROPOLO *et alii* (2006, 2008).

Lower Cretaceous ammonites of this eastern Iberian cordillera were also studied by MARTINEZ *et alii* (1994), who wrote (in Lower Aptian, p. 346-347): "La Zona Deshayesi" (...) "se halla identificada en la Fm Forcall de las cuencas de Oliete, Maestrat, El Perelló y Sallou-Garraf. Quince especies identifican, prácticamente todas, esta biozona. Pertenecen a los géneros *Deshayesites*, *Roloboceras*, *Megatyloceras*, *Toxoceratoides* y *Pseudosaynella*" (...) ". En el yacimiento de la Tejeria de Josa" (...) ", aparece la especie indice *Deshayesites deshayesi* junto a gran cantidad de ejemplares de varias especies del género *Pseudosaynella*" (...) ". Destacan también las poblaciones de *Roloboceras*" (...) "junto a *Megatyloceras* sp." Their summary table (*op. cit.*, fig. 3, p. 341) shows without ambiguity a Deshayesi Zone including the species-index accompanied by *Roloboceras* and *Megatyloceras*, that follows a Forbesi Zone including *Deshayesites weissi*. So these data agree with the work of WIEDMANN (1965), which in Spain places the *Roloboceras* level in the upper Bedoulian, not in the lower Bedoulian as SORNAY & MARIN (1972) had advocated.

The stratigraphic assignment of the Margas del Forcall Formation in the Oliete basin has been re-examined recently by MORENO *et alii* (2007). The authors insist clearly on the fact that the main fossiliferous level, a thin (0.3 m) bed of red nodular limestone located at the base of the formation, represents a condensed, probably even lacunar facies and that the assemblages of ammonoids and nautiloids that it contains are redeposited elements. A hardground separates this level from underlying massive undated limestones. In this thin bed the authors collected several species of *Roloboceras* (*hambrovi*, *transiens*, *hispanicum*), *Megatyloceras coronatum*, *Pseudosaynella* spp.and three species of *Deshayesites* which they determine as *fittoni*, *euglyphus* and *spathi*. They conclude that this level is to be attributed to the Hambrovi Subzone. But they point out: 1) that the association of *Roloboceras* and *Megatyloceras* mentioned above was attributed by CASEY to the Forbesi [# Weissi] Zone; 2) that the Deshayesitidae which accompany them at the base of the Margas del Forcall Formation in the northeastern part of the Iberian peninsula are attributed by MORENO (2007) to the upper part of the Weissi Zone. Nothing is said about the previous attribution of the same level to the Deshayesi Zone by MARTINEZ *et alii* (1994). Finally the authors mention that in the Lower Aptian sections of Le Teil (Ardèche, southeastern France) a rich assemblage with *Roloboceras* spp., *Megatyloceras*, *Subsaynella* sp., nautiloids, *etc.* and *Deshayesites consobrinus*, the latter species indicating lower Bedoulian, was recently collected [collector unspecified; probably the authors but this is not specifically stated]. In fact these findings corroborate those made in the same area by KILIAN & REBOUL (1915) (a reference not listed in MORENO *et alii*' paper). MORENO *et alii* (2007) conclude that "El análisis bioestratigráfico de los Deshayesítidos permite atribuir la Subbiozona Hambrovi a la parte alta de la Biozona Weissi cuando en otros trabajos se proponia que esta Subbiozona pertenecía a la Biozona suprayacente: Deshayesi" and "ROPOLO et al. (2000, 2006) incluyen la Subbiozona Hambrovi en la Biozona Deshayesi. Este cambio" [from the opinion of CASEY, 1961a, 1961b] "se apoyaba en las determinaciones de las especies de Deshayesítidos presentes en este intervalo. Pensamos, sin embargo, que esas determinaciones deben ser revisadas".

We think that the problem is not only to determine to which zone the Hambrovi level must be attributed, nor to question specific identifications of the Deshayesitidae, but to ascertain whether or not *Roloboceras* spp. and their accompanying assemblage have any stratigraphic value at all, without regard to possible hiatuses, reworking and mixing of faunas in condensed outcrops, all of which can lead to misinterpretation.

We have shown (ROPOLO *et alii*, 2000, 2006; MOULLADE *et alii*, 1998, 2000) (Fig. 3) that in the stratotypic area of Cassis-La Bédoule the *Roloboceras*/*Megatyloceras* assemblage occurs in an expanded section, devoid of hiatuses, where the fossil content (ammonites, foraminifers, calcareous nannofossils) is continuous and the markers succeed one another in a logical succession. Everywhere else, with the exception of southern England, there are problems: condensed facies, possible mixing and/or redeposition of faunas, poor or undated framing levels, diversity in the determination and/or placement of the Deshayesitidae, *etc.* Several potential solutions of the problem can be considered, with no clear cut explanation possible in the present state of knowledge:

The assemblage that includes *Roloboceras*, *Megatyloceras*, and nautiloids may have no precise chronostratigraphic value but represents a particular biotope [shallower, and/or more proximal, and/or more hypoxic?], that exists only when a specific set of environmental conditions occur.

The hypothesis of a phylogenetic drift must be excluded, for several genera, not all of them related, are simultaneously involved in the time shift.

Migration from the Boreal realm to the Tethys would require a certain length of time, so peregrination is unlikely as a credible explanation for the time shift because there is no significant difference in distance between southern England on the one hand, and Ardèche, eastern Spain and the Cassis-la Bédoule area on the other hand. However, the existence of some kind of temporary barrier could be invoked for the Cassis-La Bédoule basin.

The sedimentological and geometrical aspects of condensed outcrops should be investigated very carefully, to insure that fossils from several zones have not been redeposited and mixed.

To assign a chronostratigraphic significance to the Hambrovi assemblage and to discard ROPOLO *et alii*'s determinations of certain species of Deshayesitidae, as MORENO *et alii* (2007) suggested, would imply an unlikely stratigraphic interpretation of the 110m thick Cassis-La Bédoule Lower Aptian succession: an 80 m lower Bedoulian would include an anomalously thick (60 m) Weissi (= Forbesi) Zone, the entire Deshayesi Zone would be absent, and an upper Bedoulian would have a thickness of only 30 m. Such a chronologic interpretation is not consistent with the micropaleontological (planktonic foraminifera, calcareous nannofossils) and geochemical (stable isotopes, trace elements) evidence (MOULLADE *et alii*, 1998, 2000; RENARD *et alii*, 2005).

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